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Variability Study of EHB Stars in the Globular Cluster NGC 6752

Janusz Kaluzny

*Nicolaus Copernicus Astronomical Center, Bartycka 18, 00-716
Warsaw, Poland*

Ian Thompson

*Observatories of the Carnegie Institution of Washington, 813 Santa
Barbara Street, Pasadena, California 91101*

Abstract. We present the results of a search for variable stars in the central part of the globular cluster NGC 6752. The monitored sample included 160 BHB and 107 EHB stars, respectively. A total of 17 variables were detected of which 14 are new identifications. Five variables are BHB/EHB stars. We report also on identification of a detached eclipsing binary being likely a member of the cluster. Moreover, we detected an outburst of a dwarf nova located in the cluster core.

1. Introduction

NGC 6752 is a nearby post core-collapsed globular cluster. In his compilation Harris (1996) lists for it $(m - M)_V = 13.02$ and $E(B - V) = 0.04$. The cluster harbors a rich population of blue horizontal branch (BHB) and extreme horizontal branch (EHB) stars (Buonanno et al. 1986; Momany et al. 2002). The photometric survey conducted with the 1-m Swope telescope by the CASE group (Thompson et al. 1999) resulted in detection of 3 SX Phe stars and 8 eclipsing binaries in the cluster field. So far none of the blue stars in NGC 6752 is a known photometric variable. This is a bit unexpected in light of the idea that most or even all EHB stars are components of close binary systems (Mengel, Norris, & Gross 1976; Heber et al. 2002). Close binaries are common among field EHB stars (Maxted et al. 2001; Napiwotzki et al. 2004). On the other hand Moni Bidin et al. (2006) detected no spectroscopic binaries among 51 BHB/EHB stars in NGC 6752. Further evidence for a lack of close binaries among EHB stars in globular clusters was presented during this conference by Moni Bidin.

In this contribution we present results of a new survey for photometric variables in NGC 6752. It covers smaller area than our earlier work but is deeper and better suited for study of the innermost region of the cluster.

2. Observations and Reductions

The central part of the cluster was observed with the 2.5-m DuPont telescope during 8 consecutive nights in May 1998. The 2048² TEK5 CCD camera was

used as a detector with a scale of 0.26 arcsec/pixel and field of view of 8.8×8.8 arcmin². The cluster was monitored for a total of 30 hours with *B* & *V* filters. The average exposure times were 35s and 60s for *V* and *B* filters, respectively. Such rather short exposure times helped to avoid saturation of too many stars in the dense core region of the cluster. The sequences of 2-4 individual images were combined to improve the signal to noise ratio and to speed up data reductions. The results presented here are based on 152 combined images in *V* and 143 combined images in *B*. Effective resolution of the data ranges from 4 to 8 minutes.

Photometric reductions were conducted using Daophot/Allstar (Stetson 1987) and ISIS (Alard & Lupton 1998) packages. The light curves for about 30 000 stars were extracted and analyzed for variability using AoV and AOVTRANS programs (Schwarzenberg-Czerny 1996; Schwarzenberg-Czerny & Beaulieu 2006).

3. Results

We detected 17 variable stars of which 14 are new identifications. Location of 15 of them is marked on the color magnitude-diagram of the cluster shown in Fig. 1.

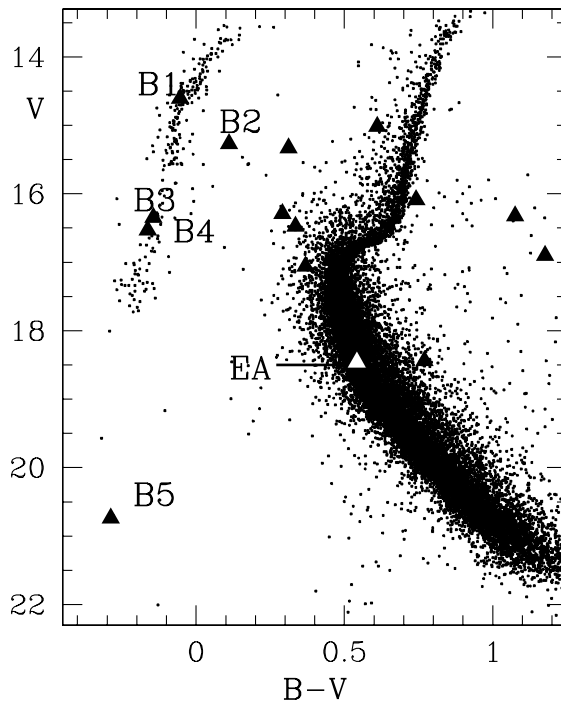


Figure 1. Color-magnitude diagram of NGC 6752 with marked variables.

Stars B1 and B3-5 are candidate BHB/EHB objects. As for variable B2 it is a likely binary containing BHB/EHB star and a redder companion. Time domain

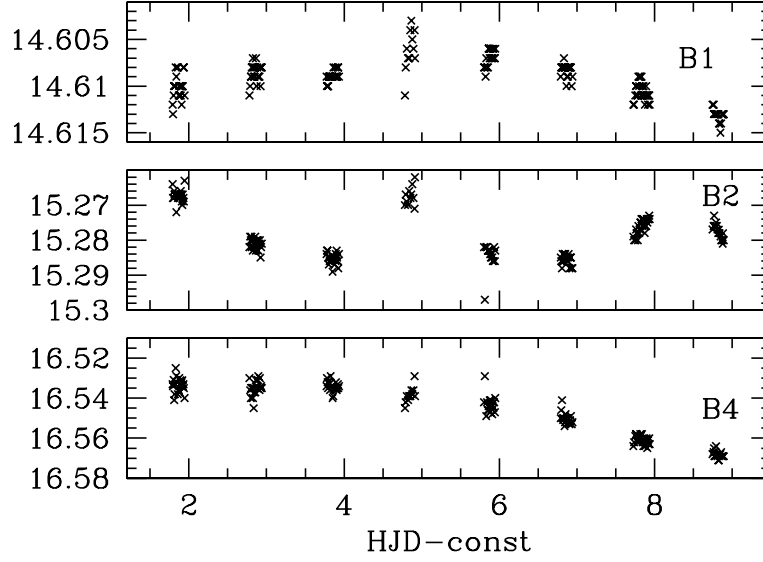


Figure 2. V-band light curves of variables B1-2 and B4.

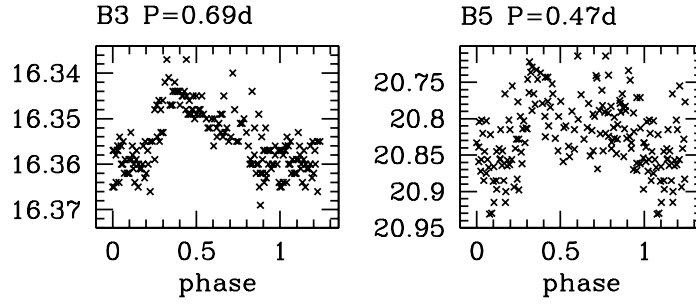


Figure 3. V-band light curves of variables B3 and B5.

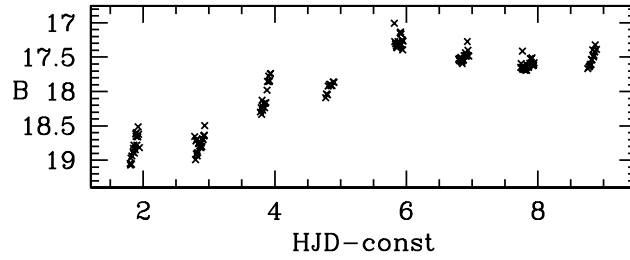


Figure 4. B-band light curve of a candidate dwarf nova.

light curves of B1, B2 and B4 are shown in Fig. 2. Light curve of B2 shows likely periodicity with $P \approx 3.3$ d or $P \approx 6.6$ d. It is possible that all 3 objects are binaries and that their variability is due to ellipsoidal and/or reflecting effect. Light curves of B3 and B5 can be phased with periods $P = 0.69$ d and $P = 0.47$ d, respectively. Their phased light curves are shown in Fig. 3. The light curve of B3 is asymmetric which suggests that it is a pulsating variable. However, the observed period is too long as for pulsating sdB star. As for B5 we propose, based on its faintness and observed period, that it is related to cataclysmic variables. We note parenthetically that B5 is also a UV bright object with $U - B \approx -1.0$. As for the remaining variables we would like to highlight a detection of a detached eclipsing binary which is located on the cluster main sequence. On Fig. 1 this variable is labeled as EA. We detected only one eclipse for it with a depth of about 0.2 mag in the V-band. The eclipse seems to be total. Detailed analysis of this object can provide a direct determination of absolute parameters for two main sequence stars belonging to the cluster. Finally, we report on a detection of a possible dwarf nova outburst for an object located right at the cluster core. Only B band light curve could be extracted for it. Photometry in the V band was impossible due to a presence of a nearby bright stars with saturated images. The light curve of the candidate dwarf nova is shown in Fig. 4.

Pooley et al. (2002) reported detection of several X-ray sources in the core of NGC 6752. It remains to be checked if any of these sources corresponds to the object which showed an optical outburst. More detailed analysis of all detected variables will be presented soon. In particular we plan an extraction of light curves based on individual images rather than on stacked frames. Moreover, we are aiming at spectroscopic follow up of selected variables. Spectroscopic data will allow in particular to check on the binary nature of detected blue variables.

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